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I. INTRODUCTION

Imagine meeting an old and trusted friend for coffee at an outdoor café or for a stroll in a quiet park. In the comfortable context of such a get-together, the conversation can roam over just about any subject that comes to mind, whether of family or fantasy, no matter how trivial or personal. Your friendship enables you to let down your guard and reveal your true self, to try out new ideas, or even to play devil's advocate in some pleasant debate. During your intimate discussion, a moth happens to alight on a nearby table or bench. In response, your friend suddenly stiffens, places her finger to her lips and says, "Let's change the subject to something safer; that moth might be after us." Realizing that she is not joking, your friend's behavior strikes you as so bizarre that it crosses your mind that your friend might be suffering through some acutely stressful time—trouble at work, at home, or of health. You even consider whether your trusted confidant is experiencing paranoid delusions.

Or, perhaps, your friend is correct. A well-funded department of the United States federal government, the Defense Advanced Research Projects Agency (DARPA) of the Department of Defense,[1] is investing millions of dollars[2] in an effort to insert electronics into moths and other insects.[3] DARPA hopes that the resulting insect "cyborgs" will enable the U.S. to fight terrorists, even in remote terrorist training camps in places such as the "hills of northern Pakistan."[4] Mandyam Srinivasan, professor of visual

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1. Jonathan Richards, *Can Cyborg Moths Bring Down Terrorists?*, TIMES ONLINE, May 24, 2007, http://technology.timesonline.co.uk/tol/news/tech_and_web/article1831494.ece?.

2. DARPA's Microsystems Technology Office (MTO) "has devoted more than US $2 million to the Hybrid Insect MEMS (HI-MEMS) program." Roland Piquepaille's Technology Trends: How New Technologies Are Modifying Our Way of Life, *Autonomous Insect Cyborg Sentinels*, June 22, 2007, http://www.primidi.com/2007/06/22.html.

3. R. Colin Johnson, *Insect Cyborgs Go Undercover*, http://www.tectrends.com/cgi/showan?an=00168087. (last visited July 26, 2008).

4. Richards, *supra* note 1.

neuroscience at the University of Queensland, envisions the cyborgs flying "inside buildings, entering through windows and doors inconspicuously," and taking movies and recording sounds while perching unsuspected on a wall.[5] Whatever intrusions moths could perform on terrorists could also be turned upon citizens. Thus, these insects could "be used in a variety of military and homeland security applications," including detecting explosives, toxins, or drugs as well as potentially hunting down robbers.[6]

Combining such powerful technology with common bugs could potentially implicate privacy and search and seizure issues under the Fourth Amendment.[7] This article examines the potential impact of cyborg moth technology on the Fourth Amendment right against unreasonable searches. Part II explores the progress and abilities of DARPA's cyborg moth technology. Part III reviews the historical background of the Fourth Amendment "search." Part IV focuses on the potential concerns created by DARPA's cyborg moths.

II. THE NEW CYBORG MOTH SURVEILLANCE TECHNOLOGY

The U.S. government is actively pursuing a plan to create "cyborg moths" that will enable the military to investigate, and possibly attack, terrorists.[8] Scientists create moth cyborgs by implanting a computer chip in a moth's body while it is still a pupa in the cocoon, relying on the insect's natural development to surround the implant with its own flesh.[9] The chip can remotely control the moth's entire nervous system, allowing the insect to land in a "camp without arousing suspicion, all the while beaming video and other information back to its masters via what its developers refer to as a 'reliable tissue-machine interface.'"[10] As mentioned, the terrorist-fighting moth is one particular project being researched by DARPA.[11]

DARPA, an agency created in 1958 months after the Soviet launch of Sputnick, describes its hybrid insect microelectromechanical systems (HI-

5. Richard Macey, *The Name's Bogong – James Bogong*, THE SYDNEY MORNING HERALD, Oct. 13, 2007, http://www.smh.com.au/news/national/the-names-bogong—james-bogong/2007/10/12/1191696173795.html.

6. Bill Christensen, *Implants Create Insect Cyborgs*, LIVE SCIENCE, Feb. 4, 2008, http://www.livescience.com/strangenews/080204-cyborg-insect.html.

7. U.S. CONST. amend. IV ("The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue, but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized").

8. *See* Richards, *supra* note 1.

9. *Id.*

10. *Id.*

11. *Id.*

MEMS) program as merely a continuation of humanity's previous reliance on animals, reasoning that the:

> Animal world has provided mankind with locomotion over millennia. For example we have used horses and elephants for locomotion in wars and conducting commerce. Birds have been used for sending covert messages, and to detect gases in coal mines, a life-saving technique for coal miners.[12]

DARPA's HI-MEMS program, which is "aimed at developing tightly coupled machine-insect interfaces by placing micro-mechanical systems inside the insects during the early stages of metamorphosis," is considered to be akin to humanity's use of "saddles and horseshoes" needed for "horse locomotion control."[13] Such "intimate control" of insects by "embedded microsystems" enables a scientist to harness an animal's own locomotion system, and thus benefit from millions of years of evolutionary progress.[14]

In 2006, DARPA solicited research in HI-MEMS that would exploit the "healing processes from one metamorphic stage to the next," which would be an improvement over earlier systems that were attached to adult insects through adhesive bonds.[15] Although the agency preferred flying insects, such as moths or dragonflies, DARPA would also consider insects that hopped or swam.[16] Such bugs would be steered by "electronic remote control" or GPS and would carry "gas sensors, microphones, video, etc."[17]

If hijacking another being's body to spy on adversaries sounds inspired by science fiction, there is good reason for this. In fact, the director of HI-MEMS, Dr. Amit Lal, read Thomas Easton's 1990 novel, *Sparrowhawk*, which "imagine[d] bioengineering-enlarged birds and insects used as beasts of burden."[18] In *Sparrowhawk*, Easton envisioned "implanting computer chips into genetically engineered insects and other animals," to create birds that serve as airliners and beetles that grow into automobiles.[19] Intrigued by Easton's ideas, DARPA invited Easton to speak at the "kickoff meeting" for the HI-MEMS program.[20] In his online presentation, Easton speculated about the tasks that insect cyborgs could fulfill in the future, such as gather-

12. Amit Lal, Hybrid Insect MEMS (HI-MEMS), http://www.darpa.mil/MTO/programs/himems/index.html (last visited July 26, 2008).

13. *Id.*

14. *Id.*

15. DARPA, Hybrid Insect Mems (HI-MEMS) Presolicitation Notice, March 9, 2006, http://www.darpa.mil/mto/solicitations/baa06-22/index.html.

16. *Id.*

17. *Id.*

18. Johnson, *supra* note 3.

19. *Id.*

20. *Id.*

ing intelligence, penetrating secret meetings, tracking targets, and retrieving samples.[21] Easton even suggested that law enforcement use cyborg moths: "Moths are extraordinarily sensitive to sex attractant, so instead of giving bank robbers money treated with dye, [police] could use sex attractant instead. Then, a moth-based HI-MEMS could find the robber by following the scent."[22]

The daring HI-MEMS project fits with the culture of DARPA, whose mission, in part, is "to develop imaginative, innovative and often high-risk research ideas offering a significant technological impact that will go well beyond the normal evolutionary developmental approaches."[23] The *Department of Defense Directive 5134.10* provides that "DARPA shall serve as the central research and development organization of the Department of Defense with a primary responsibility to maintain U.S. technological superiority over potential adversaries."[24] Therefore, DARPA scientists and engineers have the responsibility to pursue "hard problems" or the "unobtainiums."[25] DARPA's ambition has led to some failures, such as a mechanical elephant meant to negotiate the jungles of Vietnam, building an "infectious polio virus from its chemical components," and the "Total Information Awareness Project," which was intended to ferret out terrorists by mining credit card and computer-use data.[26] Yet such bold thinking also led to a string of major accomplishments. Emphasis on innovation, along with a budget of as much as $3.1 billion annually, has helped DARPA make contributions to the Saturn rocket, the M-16 rifle, the stealth fighter, the Global Positioning System, the

21. *Id.*

22. *Id.* The science fiction aspect of DARPA's HI-MEMS program has already attracted some ridicule. The Register, whose motto is "Biting the Hand that Feeds IT," reported, "[f]or now DARPA only aims to manufacture chipped moths, which it reckons to send into suspected terrorist facilities (presumably including al-Qaeda linen cupboards – that'll show them)." Lewis Page, *DARPA to Create Brain-Chipped Cyborg Moths*, THE REGISTER, May 31, 2007, http://www.theregister.co.uk/200705/31/cyborg_chipped_terminator_moths_aiee/. Likewise, a posting on the blog titled "The Incontiguous Brick" joked that, "[u]nfortunately, terrorists may have already developed a method to fight this bug-based threat . . . moth balls." The Incontiguous Brick, May 25, 2007, http://incontiguousbrick.com/2007/05/25/terrorists-have-new-technology-to-defeat-cyborg-moth.

23. AMIT LAL, HYBRID INSECT MEMS PROPOSER'S DAY 1 (2006), www.darpa.mil/MTO/solicitations/baa06-22/pdf/lal_proposersday.pdf.

24. *Id.*

25. Hurst, *supra* note 12, at 2.

26. *Id.* at 3-4.

Predator drone, the Hubble telescope,[27] high-energy lasers, and night-vision goggles.[28]

To assist its HI-MEMS program, DARPA has awarded funding to research groups at the University of Michigan, Massachusetts Institute of Technology (MIT), and Boyce Thompson Institute.[29] According to a DARPA spokesperson, the University of Michigan research group has focused on horned beetles, while the groups at MIT and Boyce Thompson are working on large moths.[30] Meanwhile, several scientists at Cornell University have written papers describing their progress inserting a microprobe into the tobacco hawkmoth, Manduca sexta.[31] The Cornell scientists' first experiments were designed to overcome previous difficulties encountered when payloads were either strapped onto the adult insect like backpacks or were bonded to their body surface with adhesive.[32] Perceiving these attachments as "foreign weights," the insects tried to get rid of the payloads that were superficially attached to their bodies.[33] The scientists at Cornell sought to avoid this problem by surgically inserting "microsystems in the pupal stage (an early stage of metamorphosis) when the insect was immobile."[34] These surgeries eventually created "an adult moth with the platform/silicone-piece permanently attached onto the insect as the adult had healed over the inserted artifacts."[35] Not only did the resulting moths perceive the implant as part of their own body weight instead of extra or foreign weight, but the survival rates of these moths were comparable to those of normal unaltered moths.[36] The Cornell scientists also noted that the "new tissue interface" could eventually lead to the development of devices that "could be integrated into the insect tissue system like muscles or nerves to control the insect's behavior (movement)."[37] Such movement could be manipulated by "pheromones, changes in wave-

27. LAL, *supra* note 23.

28. Daniel Engber, *I Want to Be a Mad Scientist*, SLATE, Aug. 8, 2007, http:/www.slate.com/id/2171923/entry/2171925/.

29. Johnson, *supra* note 3.

30. *Id.*

31. Alper Bozkurt et al., *Microprobe Microsystem Platform Inserted During Early Metamorphosis to Actuate Insect Flight Muscle*; Ayesa Paul et al., *Surgically Implanted Micro-Platforms in Manduca Sexta Moths*; A. Bozkurt et al., *MEMS Based Bioelctronic Neuromuscular Interfaces for Insect Cyborg Flight Control.*

32. Bozkurt et al., *supra* note 31.

33. *Id.*

34. *Id.*

35. *Id.*

36. *Id.*

37. Paul et al., *supra* note 31, at 1.

length of light, and to various frequencies of ultrasound."[38] Further, like any prudent potential manufacturer, the scientists at Cornell predict future mass production, stating that because the moth's "emergence time into the adult stage can be manipulated (lengthened) with temperature and/or other environmental stimuli" there is a "possibility of mass producing hybrid insect biobots and on time deployment of the insect at the target site."[39]

After repeated success implanting microprobes, the Cornell scientists have coined a name for their new technology, Early Metamorphosis Insertion Technology (EMIT), and also refer to their insertions as "part of the body" of the "insect cyborgs."[40] After inserting a microprobe, the Cornell scientists have directed "actuation of flight muscles," which enables the scientists to selectively control the moth's wing motion.[41] Specifically, the Cornell researchers found that "upstroke and downstroke actuation of 'one' or both wings were demonstrated with power consumption of as low as 10 microWatts. By tethering the moth, we were able to affect the direction of insect flight by controlling the motion of the wing."[42]

The Cornell researchers' advances have attracted worldwide attention. Mandyam Srinivasan, professor of visual neuroscience at the University of Queensland, Australia, visited Cornell University, where one of the scientists told Professor Srinivasan that she was capable of steering a moth.[43] In response to this news, Professor Srinivasan advised Australia's press that "[i]t is just a matter of time" before insect-like spies are on the way.[44]

Furthermore, cyborg moth technology will have a practical impact in the real world. According to Rod Brooks, director of MIT's computer science and artificial intelligence lab, HI-MEMS is just one of several technologies that will soon be deployed in combat zones.[45] Dr. Brooks, who has been working with robotic technology for over thirty years, asserts that HI-MEMS "is going to happen. It's not science like developing the nuclear bomb, which costs billions of dollars. It can be done relatively cheaply."[46] To give a sense of the scale of HI-MEMS technology, Dr. Brooks notes that "the DoD has said it wants one third of all missions to be unmanned by 2015."[47] In this

38. *Id.* at 1-2.

39. *Id.* at 3.

40. Bozkurt et al., *supra* note 31, at 1.

41. *Id.* at 4.

42. *Id.*

43. Macey, *supra* note 5.

44. *Id.*

45. Richards, *supra* note 1.

46. *Id.* Dr. Amit Lal, in his HI-MEMS Proposer's Day presentation, estimated that "low cost cyborgs" such as "Micro-UAV's (Unmanned Air Vehicles)" could be built for $15. LAL, *supra* note 23.

47. Richards, *supra* note 1.

regard, Brooks raises a particularly ominous prospect: "There's no doubt their things will become weaponised, so the question [be]comes: should they be given targeting authority?"[48] Brooks thus wonders whether "it's time to consider updating treaties like the Geneva Convention to include clauses which regulate their use."[49]

Others foresee cyborg insects being employed beyond the battlefield. For instance, if moths could survey terrorists abroad, they could do so at home as well. Thus HI-MEMS might be used for "homeland security applications."[50] Such a prospect raises a fundamental concern, as noted by Peter Eckersley of the Electronic Frontier Foundation: "Anyone who is just a little bit creative can imagine both useful and nonproductive applications of remote-controlled animals – especially if ordinary people will mistake them for normal animals."[51] Eckersley is concerned that if "people in a free society have to start worrying that any insect they see might be conducting surveillance, then that could seriously inhibit their ability to develop their character and express themselves."[52]

III. A Threshold Issue of Fourth Amendment Application: What Constitutes a Fourth Amendment "Search?"

However strange they seem, cyborg moths are hardly the first technological advance implicating Fourth Amendment privacy concerns. A short history of the evolution of eavesdropping can be found in *Berger v. New York*, a U.S. Supreme Court case in which the state liquor authority was involved in a bribery conspiracy.[53] In *Berger*, as a result of "numerous complaints" to the District Attorney's Office regarding the forced payment of bribes for liquor license applications, officials obtained 60-day eavesdrop orders to record conversations taking place in conspirators' offices.[54] The defendant sought to suppress the recordings that resulted from the eavesdropping, contending that such surveillance violated the Fourth Amendment.[55]

The *Berger* Court, in an opinion authored by Justice Clark, ultimately held that the government wiretapping, performed pursuant to New York statute, did indeed violate the Fourth Amendment.[56] Before reaching this conclu-

48. *Id.*

49. *Id.*

50. Christensen, *supra* note 6.

51. Johnson, *supra* note 3.

52. *Id.*

53. Berger v. New York, 388 U.S. 41, 44 (1967).

54. *Id.* at 45.

55. *Id.* at 43.

56. *Id.* at 44.

sion, however, Justice Clark considered the history of eavesdropping, recognizing it as "an ancient practice" originally involving nothing more sophisticated than listening "by naked ear under the eaves of houses or their windows, or beyond their walls seeking out private discourse."[57] The advent of electricity enabled snoops to avoid the awkwardness and indignity of actual physical presence by intercepting messages from telegraph lines, thus empowering newspapers to steal competitors' scoops, bettors to cheat on racing, and Confederate General J.E.B. Stuart to spy on the Union's military communications.[58] In *Berger*, the Supreme Court noted that "the telephone brought on a new and more modern eavesdropper known as the 'wiretapper,'"[59] and identified the Court's first wiretap case, *Olmstead v. United States*.[60]

In *Olmstead*, the defendant was the lead conspirator of a business that was violating the National Prohibition Act by selling as much as "200 cases of liquor per day."[61] Four federal prohibition agents who tapped the phone lines of several conspirators obtained the information that exposed the conspiracy.[62] The agents made the insertions into the phone lines, without trespassing upon any of the defendants' property, by tapping into lines from the homes "in the streets near the houses."[63] Justice Taft, writing for the Court, found it relevant that the persons "who intercepted the projected voices [along the phone wire] were not in the house of either party to the conversation," and thus performed no "actual physical invasion" of a house.[64] The *Olmstead* Court concluded that the Fourth Amendment did not prohibit the wiretapping in this case, and that "[t]here was no searching" because there "was no entry of the houses or offices of the defendants."[65]

The Supreme Court adhered to its physical invasion trigger for a Fourth Amendment search when it considered its first "bugging" case, *Goldman v. United States*.[66] In *Goldman*, an informant named Hoffman alerted government officials that Martin Goldman was conspiring to violate the Bankruptcy Act.[67] Two federal agents placed a "detectaphone," a device "having a receiver so delicate as, when placed against the partition wall, to pick up sound

57. *Id.* at 45.

58. *Id.* at 45-46.

59. *Id.* at 46.

60. *Id.* at 50 (citing Olmstead v. United States, 277 U.S. 438, 447(1928)).

61. *Olmstead*, 277 U.S. at 456.

62. *Id.*

63. *Id.* at 457.

64. *Id.* at 466.

65. *Id.* at 464.

66. Goldman v. United States, 316 U.S. 129, 134-35 (1942).

67. *Id.* at 130-31.

waves originating in [the adjacent] office," against the wall next to an office in which Hoffman was scheduled to meet with Goldman.[68] The agents then overheard the resulting conversations involving, among other participants, Hoffman and Goldman.[69] In the following prosecution, Goldman argued that the evidence gained via the detectaphone was obtained in violation of the Fourth Amendment.[70]

The *Goldman* Court, in an opinion by Justice Roberts, held that what the agents heard through use of the detectaphone was "not made illegal by trespass or unlawful entry" and that the government's use of the device did not violate the Fourth Amendment.[71] The defendant tried to distinguish his case from *Olmstead* by arguing that when "one talks in his own office, and intends his conversation to be confined within the four walls of the room, he does not intend his voice shall go beyond those walls and it is not to be assumed he takes the risk of someone's use of a delicate detector in the next room."[72] Justice Roberts considered such a distinction "too nice for practical application of the Constitutional guarantee," and chose instead to adhere to the *Olmstead* definition of a Fourth Amendment search, which focused on whether trespassing had occurred.[73]

It would take a quarter-century for the Supreme Court to be persuaded by the argument advanced by Goldman's lawyers. By 1967, in *Katz v. United States*, the Supreme Court accepted the idea of defining a Fourth Amendment search based on a person's intentions, or expectations.[74] In *Katz*, FBI agents who suspected Katz of gambling activity placed "an electronic listening and recording device" on the outside of a public phone booth that Katz frequented.[75] When Katz objected to the use of the resulting recorded conversations, the litigants and lower courts framed the Fourth Amendment issue as one of whether the government had physically penetrated a constitutionally protected area.[76]

Justice Stewart, authoring the opinion, rejected the Supreme Court's own "constitutionally protected area" formulation as deflecting attention from the true issue at hand.[77] The *Katz* Court found that the Fourth Amendment's scope could not be delineated by "the presence or absence of a physi-

68. *Id.* at 131-32.

69. *Id.* at 132.

70. *Id.*

71. *Id.* at 134-35.

72. *Id.* at 135.

73. *Id.*

74. Katz v. United States, 389 U.S. 347, 353 (1967).

75. *Id.* at 348.

76. *Id.* at 349-50.

77. *Id.* at 351.

cal intrusion into any given enclosure,"[78] noting that "[t]he fact that the electronic device employed . . . did not happen to penetrate the wall of the booth can have no constitutional significance."[79] Instead, the Court held that the Fourth Amendment protected people, and not places, because "[w]hat a person knowingly exposes to the public, even in his own home or office, is not a subject of Fourth Amendment protection. But what he seeks to preserve as private, even in an area accessible to the public, may be constitutionally protected."[80] The government contended that any privacy interest Katz may have had was undermined by the fact that the "telephone booth from which [Katz] made his calls was constructed partly of glass, so that he was as visible after he entered it as he would have been if he had remained outside."[81] Unpersuaded by this reasoning, Justice Stewart instead focused on Katz's expectations, stating that "what [Katz] sought to exclude when he entered the booth was not the intruding eye—it was the uninvited ear."[82] The *Katz* Court found that an individual's right against improper police intrusion did "not vanish when the search in question [was] transferred from the setting of a home, an office, or a hotel room to that of a telephone booth. Wherever a man may be, he is entitled to know that he will remain free from unreasonable searches and seizures."[83]

It ultimately fell to Justice Harlan, in his concurring opinion in *Katz*, to formulate the definition of a Fourth Amendment search that has since become the Supreme Court's rule. In outlining the elements for Fourth Amendment protection, Justice Harlan required, "[f]irst[,] that a person have exhibited an actual (subjective) expectation of privacy and, second, that the expectation be one that society is prepared to recognize as 'reasonable.'"[84] Furthermore, Justice Harlan explained that the ultimate issue was whether the individual expected his words to be overheard, because "'[o]ne who occupies it, (a telephone booth) shuts the door behind him, and pays the toll that permits him to place a call is surely entitled to assume' that his conversation is not being intercepted."[85]

In later decisions, the Court adopted Harlan's "reasonable expectation of privacy" definition of the Fourth Amendment in a whole host of contexts. For instance, in *Mancusi v. Deforte*, the Court considered the reasonableness of a Teamsters official's "expectation of freedom from government intru-

78. *Id.* at 353.

79. *Id.*

80. *Id.* at 351 (citations omitted).

81. *Id.* at 352.

82. *Id.*

83. *Id.* at 359.

84. *Id.* at 361 (Harlan, J., concurring).

85. *Id.* (citations omitted).

sion" in an office he shared with other union officials.[86] Additionally, in *Smith v. Maryland*, the Court determined whether a caller's expectation that the numbers he dialed from his phone would remain private was "one that society [was] prepared to recognize as reasonable."[87] The Court also weighed the reasonableness of privacy expectations of trash left in bags on the street curb for pick up in *California v. Greenwood*.[88] It analyzed bus passengers' expectations that their overhead luggage would be free from exploratory squeezing by government agents in *Bond v. United States*.[89] These examples provide only a partial listing of the cases in which the Court has relied on *Katz's* reasonable expectation of privacy test to define a Fourth Amendment search.

The Court also applied the privacy-expectation standard of *Katz* to radio transmission of conversations by a government informant in *United States v. White*.[90] In that case, the defendant was convicted of various narcotics violations after he spoke to an informant in the defendant's home, the informant's home, a restaurant, and the informant's car.[91] Agents overheard these conversations through a radio transmitter hidden under the informant's clothing.[92]

In assessing an individual's expectation of privacy, Justice White relied on the old maxim that "there is no honor among thieves," because a person "contemplating illegal activities must realize and risk that his companions may be reporting to the police."[93] Furthermore, the Court determined that a criminal's untrsutworthiness did not somehow change with progress in sound technology. Since "the law permits the frustration of actual expectations of privacy by permitting authorities to use the testimony of those associates who for one reason or another have determined to turn to the police," the law should neither shield a criminal when those same associates have "recorded or transmitted the conversations which are later offered in evidence to prove the State's case."[94] The Court came to this conclusion despite the increased potency of electronically recorded evidence to negatively impact a defendant's case. Justice White acidly pointed out:

> An electronic recording will many times produce a more reliable rendition of what a defendant has said than will the unaided

86. Mancusi v. Deforte, 392 U.S. 364, 368 (1968).

87. Smith v. Maryland, 442 U.S. 735, 743 (1978).

88. California v. Greenwood, 486 U.S 35, 39 (1988).

89. Bond v. United States, 529 U.S. 334, 335 (2000).

90. United States v. White, 401 U.S. 745, 754 (1971).

91. *Id.* at 746-47.

92. *Id.* at 747.

93. *Id.* at 752.

94. *Id.*

> memory of a police agent. It may also be that with the recording in existence it is less likely that the informant will change his mind, less chance that threat or injury will suppress unfavorable evidence and less chance that cross-examination will confound the testimony. Considerations like these obviously do not favor the defendant, but we are not prepared to hold that a defendant who has no constitutional right to exclude the informer's unaided testimony nevertheless has a Fourth Amendment privilege against a more accurate version of the events in question.[95]

Likewise, in *United States v. Knotts*, the Supreme Court did not shrink from the prospect of government use of a "beeper," a radio transmitter that emits periodic signals that are picked up by a radio receiver.[96] In *Knotts*, the Minnesota Bureau of Criminal Apprehension learned that Knotts, together with co-defendants Petschen and Armstrong, would attempt to buy chloroform, a precursor chemical used to manufacture illicit drugs such as methamphetamine.[97] With consent of the seller, the police placed a beeper on a five-gallon container of chloroform and then, after Armstrong purchased it, followed the car containing the chloroform, "maintaining contact by using both visual surveillance and a monitor which received the signals sent from the beeper."[98] Officers followed the vehicle as it crossed from Minnesota into Wisconsin, relying on a helicopter to pick up the beeper's signal after losing visual contact of the car.[99] The beeper led officials to Knotts's cabin, where a search pursuant to a warrant revealed a fully operable drug laboratory, as well as the drum of chloroform that Armstrong had purchased earlier.[100] Knotts challenged the warrantless beeper tracking as a violation of the Fourth Amendment and sought to have the evidence of the choloroform and methamphetamine lab suppressed.[101]

The *Knotts* Court equated the beeper surveillance with following a car on public roads, and thus returned to its own precedent regarding the reduced expectations of privacy in cars:

> A person traveling in an automobile on public thoroughfares has no reasonable expectation of privacy in his movements from one place to another. When [Knotts] traveled over the public streets he voluntarily conveyed to anyone who wanted to look the fact that he was travelling over particular roads in a particular di-

95. *Id.* at 753.

96. United States v. Knotts, 460 U.S. 276, 277 (1983).

97. *Id.*

98. *Id.* at 278.

99. *Id.*

100. *Id.* at 279.

101. *Id.*

> rection, the fact of whatever stops he made, and the fact of his final destination when he exited from public roads onto private property.[102]

Quite simply, "[v]isual surveillance from public places" along the defendants' driving route would have sufficiently revealed this information to the police.[103] That the police used existing technology in the form of a beeper did not make the search illegal because "[n]othing in the Fourth Amendment prohibited the police from augmenting the sensory faculties bestowed upon them at birth with such enhancement as science and technology afforded them in this case."[104]

Justice Rehnquist, writing for the Court in *Knotts*, compared the driver in *Knotts* to the telephone caller in *Smith v. Maryland*.[105] In *Smith*, the government used a pen register to record the phone numbers that Smith dialed from his home phone.[106] The *Knotts* Court approvingly quoted *Smith* at length:

> This analysis dictates that [Smith] can claim no legitimate expectation of privacy here. When he used his phone, [Smith] voluntarily conveyed numerical information to the telephone company and 'exposed' that information to its equipment in the ordinary course of business. In so doing, [Smith] assumed the risk that the company would reveal to police the numbers he dialed. The switching equipment that processed those numbers is merely the modern counterpart of the operator who, in an earlier day, personally completed calls for the subscriber. [Smith] concedes that if he had placed the calls through an operator, he could claim no legitimate expectation of privacy. We are not inclined to hold that a different constitutional result is required because the telephone company has decided to automate.[107]

Like Smith dialing his phone, the conspirators in *Knotts* assumed the risk when driving on public streets that anyone, including the government, could observe and collect information exposed by their activity. When the *Knotts* Court considered that its holding might allow "twenty-four hour surveillance of any citizen of this country" unrestricted by judicial oversight or permission, it deemed the risk of such a possibility to be acceptable.[108]

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102. *Id.* at 282.

103. *Id.*

104. *Id.*

105. *Id.* at 283 (citing Smith v. Maryland, 442 U.S. 735, 737 (1978)).

106. *Smith*, 442 U.S. at 737.

107. *Knotts*, 460 U.S. at 283.

108. *Id.*

However, the Supreme Court did place an important limit on beeper surveillance in *United States v. Karo*.[109] The record in *Karo*, unlike *Knotts*, indicated that government agents continued to monitor the beeper after determining that the can containing it was inside the defendant's house.[110] The *Karo* case involved government intrusion of a private residence, a "location not open to visual surveillance."[111] Because the government used an electronic device to obtain "information that it could not have obtained by observation from outside the curtilage of the house," the government learned "a critical fact about the interior of the premises that [it] . . . could not have otherwise obtained without a warrant."[112] The *Karo* Court concluded that "[i]ndiscriminate monitoring of property that has been withdrawn from public view would present far too serious a threat to privacy interests in the home to escape entirely some sort of Fourth Amendment oversight."[113]

This indoor versus outdoor distinction continued to play a pivotal role in *Kyllo v. United States*.[114] In *Kyllo*, an agent for the United States Department of Interior pointed a "thermal imaging device" from his car at Danny Kyllo's private home.[115] By converting heat into visual pictures, the thermal imager showed the agent that Kyllo's garage was "relatively hot" compared to the rest of the house and, thus, a likely location for marijuana cultivation.[116] The thermal imaging information formed part of the basis for a search warrant, and the resulting search revealed an "indoor growing operation involving more than 100 plants" of marijuana.[117] The trial court denied Kyllo's motion to suppress evidence of the marijuana.[118]

Justice Scalia, writing for the Court, began his analysis by identifying the heart of the Fourth Amendment as the right of "a man to retreat into his own home and there be free from unreasonable governmental intrusion."[119] *Kyllo* thus viewed the issue as one of protecting the sanctity of the home. The Court found that the use of sense-enhancing technology to obtain "any infor-

109. United States v. Karo, 468 U.S. 705, 716 (1983).

110. *Id.* at 710. In *Knotts*, Justice Rehnquist took care to note, "[t]he record before us does not reveal that the beeper was used after the location in the area of the cabin had been initially determined." *Knotts*, 460 U.S. at 278-79. In *Karo*, by contrast, "there is no gainsaying that the beeper was used to locate the ether in a specific house." *Karo*, 468 U.S. at 714.

111. *Karo*, 468 U.S. at 710.

112. *Id.* at 715.

113. *Id.* at 716.

114. Kyllo v. United States, 533 U.S. 27, 34 (2001).

115. *Id.* at 29.

116. *Id.* at 29-30.

117. *Id.* at 30.

118. *Id.*

119. *Id.* at 31.

mation regarding the interior of the home that could not otherwise have been obtained without physical 'intrusion into a constitutionally protected area,'" constituted a search,[120] at least when the technology at issue was not generally used by the public.[121] Repeatedly tying the privacy issue to the context of a private dwelling, Justice Scalia worried about leaving the "homeowner at the mercy of advancing technology."[122] Scalia stated that in "the home . . . *all* details are intimate details, because the entire area is held safe from prying government eyes."[123] The *Kyllo* Court, thus held that a search occurred "[w]here, as here, the Government uses a device that is not in general public use, to explore details of the home that would previously have been unknowable without physical intrusion."[124] In protecting the home from thermal imaging technology, *Kyllo* circled back to a concept rejected in *Katz* - the physical intrusion of a constitutionally protected area. Furthermore, in assessing the privacy concerns posed by new technology, the Supreme Court developed a clear distinction between expectations inside and outside of the home.

IV. Implications of the Cyborg Moth Surveillance Technology on Fourth Amendment Privacy

A. The HI-MEMS Cyborg Moth Technology, Under *Katz's* "Reasonable Expectation of Privacy" Definition of a Search, Could Limit Fourth Amendment Protection

The Supreme Court has declared that in deciding "whether a particular form of government-initiated electronic surveillance is a 'search' within the meaning of the Fourth Amendment, our lodestar is *Katz v. United States*."[125] More particularly, the Court has consistently held that application of the Fourth Amendment depends on whether the individual seeking its protection "can claim a 'justifiable,' a 'reasonable,' or a 'legitimate expectation of privacy' that has been invaded by government action."[126] Thus, the determination of a "search," and access to Fourth Amendment privacy protection, often turns on the calculation of whether an individual's privacy expectations are reasonable.

How reasonable is it to expect privacy from a cyborg moth? The very consideration of the question itself seems laughable at first blush. As noted earlier, if a friend shushed a conversation out of fear that a nearby moth

120. *Id.* at 34.

121. *Id.*

122. *Id.* at 35.

123. *Id.* at 37.

124. *Id.* at 40.

125. Smith v. Maryland, 442 U.S. 735, 739 (1978).

126. *Id.* at 740.

could be eavesdropping or filming for a government agency, one would be tempted to doubt the friend's sanity. Of course, it would seem that we have every right to reasonably expect privacy from HI-MEMS insects, or any other animals for that matter.

However, a closer look at the Supreme Court's handling of the *Katz* test could cast doubt on such an assumption of privacy. Cyborg moths are a technological advance designed and intended to protect society from danger. Over the years, the Supreme Court has established a track record of accepting the government's use of technological advances in surveillance as reasonably expected. For example, in *California v. Ciraolo*, the Supreme Court was called upon to decide whether observations from an aircraft intruded upon a privacy expectation that "society is prepared to honor."[127] In *Ciraolo*, two police officers investigated an anonymous tip that Ciraolo was growing marijuana in his backyard.[128] When two fences prevented the officers from seeing Ciraolo's yard at ground level, the officers flew over the yard in a plane at the navigable airspace of 1000 feet.[129] From the plane, the police were able to identify, by naked eye, marijuana plants growing as tall as ten feet.[130] Ciraolo argued that the warrantless flyover violated the Fourth Amendment because "his yard was in the curtilage of his home."[131] Chief Justice Burger, writing for the Court, recognized that curtilage, the "area to which extends the intimate activity associated with the 'sanctity of a man's home and the privacies of life,'" is a place "where privacy expectations are most heightened."[132] Moreover, Chief Justice Burger agreed that Ciraolo's backyard and his "crop" fell within the curtilage of his home.[133] Nonetheless, the Court ruled that the Fourth Amendment did not prohibit the police's aerial observations because it was unreasonable for a citizen to expect privacy from such routinely travelled public airways.[134] Society could not "honor" Ciraolo's expectation of privacy because "[a]ny member of the public flying in this airspace who glanced down could have seen everything that these officers observed."[135] Moreover, in "an age where private and commercial flight in the public airways is routine, it is unreasonable for [Ciraolo] to expect that his marijuana plants were constitutionally protected from being observed with a naked eye from an altitude of 1,000 feet."[136]

127. California v. Ciraolo, 476 U.S. 207, 214 (1986).

128. *Id.* at 209.

129. *Id.*

130. *Id.* at 209, 213.

131. *Id.* at 212.

132. *Id.* at 212-13 (quoting Boyd v. United States, 116 U.S. 616, 630 (1886)).

133. *Id.* at 213.

134. *Id.* at 215.

135. *Id.* at 213-14.

136. *Id.* at 215.

The logic of *Ciraolo* undermines the reasonableness of any privacy expectation from cyborg moths. Since a pedestrian, walking where she is legally allowed and using nothing more than her unaided ears, could conceivably overhear a discussion between two friends enjoying what they thought was a private conversation, the government could monitor the same activity using a cyborg moth without implicating the Fourth Amendment. If a traveler on a plane can erode the reasonableness of privacy expectations from government observation of someone's curtilage – a place "where privacy expectations are most heightened" – then a person walking to work or jogging for health can likewise destroy any reasonable privacy expectations from eavesdropping cyborg moths. A picnicker in a park, shopper in a mall, or dog walker on the beach can all lawfully observe other people. Thus, an expectation of privacy from a moth equipped with a camera is likely unreasonable.

What causes further alarm is the prospect that what a private individual might do by accident or whim could pave the way for intentional government behavior. In *Ciraolo*, the Court reasoned that the police were justified in pursuing a mission aimed at peering into a particular person's backyard because a member of the flying public, by glancing out of a plane window, could have made a similar observation.[137] Following this reasoning, a bored restaurant patron could shrink privacy expectations of other diners by choosing to eavesdrop on a random conversation at the next table, opening such talks up to government intrusion.

Moreover, the force of *Ciraolo's* reasoning could suggest to DARPA that if it means to pursue its cyborg moth surveillance, the agency should release as many of the moths and employ them as often as possible. *Ciraolo* considered the reasonableness of privacy expectations to be undermined by "routine" invasion.[138] In this regard, DARPA's choice of the moth might be quite apt since "[t]here are more species of moth than all the mammals, birds, fish, and reptiles put together."[139] The moth sentinels guarding us from terrorists or criminals have such a distinct numerical advantage that they would be able to quickly and efficiently alter privacy expectations.

As technology has advanced since *Ciraolo*, the Fourth Amendment's reasonable expectation of privacy standard has retreated. In *Florida v. Riley*, a sheriff's office surpassed its law enforcement brethren in California by circling over private property in a helicopter at 400 feet.[140] Since helicopters "are not bound by the lower limits of the navigable airspace allowed to other aircraft," a plurality of the *Riley* court allowed the helicopter flyover, trimming 600 feet off of the Fourth Amendment's reasonable privacy expecta-

137. *Id.* at 213.

138. *Id.* at 215.

139. Richard Conniff, SPINELESS WONDERS: STRANGE TALES FROM THE INVERTEBRATE WORLD 172 (1996).

140. Florida v. Riley, 488 U.S. 445, 448 (1989).

tions from *Ciraolo*.[141] The *Riley* Court's reliance on the "routine" nature of helicopter flight might also encourage DARPA to generate as many moths as possible. Specifically, the Court noted that there are more than 10,000 registered helicopters, both public and private, and nearly 32,000 helicopter pilots in the United States.[142] Thus, the very release of large numbers of moths would, as a *fait accompli*, destroy the reasonableness of privacy expectations that people otherwise could have.

Katz's reasonable expectation of privacy test, combined with a new technology that can be cheaply mass-produced, could thus create a vicious cycle in which each new advance in surveillance capability diminishes a person's expectation of privacy. In turn, lower expectations of privacy lessen the scope of Fourth Amendment protection, thereby opening the way for even greater technological intrusions. At some stage, especially with the advent of a particularly powerful surveillance tool such as the cyborg moth, the Fourth Amendment guarantee against unreasonable searches begins to collapse upon itself. Continuing acceptance of technological innovation could cause *Katz's* reasonable expectation of privacy formula, once devised to protect a telephone caller's privacy, to become an instrument of government intrusion. Thus, what was once the province of the paranoid could become the new reasonable expectation.

B. Cyborg Moth Technology, when Combined with the Court's Focus on Privacy in the Home, Could Create a National Bunker Mentality

The Supreme Court does not reward those who venture outside their homes. In *Knotts*, when police used a beeper to set up a raid of Knotts' home, which ultimately revealed a $10,000 amphetamine laboratory,[143] the Court found no intrusion on "any legitimate expectation of privacy."[144] The Court reasoned that the conspirators had only themselves to blame for the police learning the whereabouts of the secret operation. Because the conspirators chose to drive a vehicle on public streets, they conveyed "to anyone who wanted to look" the facts that the car was on a specific road, was headed in a particular direction, was making various stops, and was telegraphing the "final destination" by exiting "from a public road onto private property."[145] If the conspirators wished to maintain privacy in these matters, they should

141. *Id.* at 451. Justice O'Connor, concurring in the judgment, agreed that Riley had no reasonable expectation of privacy, yet based her decision on the "routine" nature of air travel rather than the fact that the aircraft viewing Riley's property was "where it had a 'right to be.'" *Id.* at 453.

142. *Id.* at 451 n.2.

143. United States v. Knotts, 460 U.S. 276, 279 (1983).

144. *Id.* at 285.

145. *Id.* at 281-82.

never have left home; the government can only track the comings and goings of those who actually come and go.

In support of this rationale, Justice Rehnquist cited *Smith*, where an individual, by making a telephone call, sacrificed his Fourth Amendment protection regarding the numbers he was dialing.[146] When Smith dialed, he "voluntarily conveyed numerical information," thus revealing that information in the "ordinary course of business."[147] By picking up the phone, he assumed the risk that the telephone company might share the numbers entered with the police.[148] If Smith was serious about preserving his privacy in the numbers he dialed, he would not use the phone.

Technological advances that enhance the government's ability to monitor the activity of citizens in public have no constitutional significance. For instance, the use of a beeper in *Knotts* was acceptable under the Fourth Amendment because nothing "prohibited the police from augmenting the sensory faculties bestowed upon them at birth with such enhancement as science and technology afforded them in this case."[149] Likewise, in *Smith*, the Court found no danger in technology's progress because the Court was "not inclined to hold that a different result is required because the telephone company has decided to automate."[150] In *White*, the Court found "no persuasive evidence that the difference . . . between the electronically equipped and the unequipped agent is substantial enough to require discrete constitutional recognition."[151]

Following the Court's reasoning to its logical conclusion, one could only guarantee Fourth Amendment protection from cyborg moths by ceding public areas to them and staying indoors. Such thinking ignores the fact that private moments often occur out in the open, with those involved expecting human decency to prevent intrusion. For instance, a person might propose marriage while walking on a public beach or picnicking in a state park, creating a life-long memory in a place of beauty. Another might seek a loan from a friend over a cup of coffee in a donut shop or suburban mall, and would cringe to think that such a personal low could be the subject of public knowledge. Family members might meet at a diner or cafeteria to discuss the health prospects of a loved one who has been hospitalized, without expecting others to eavesdrop on the personal and painful details. Indeed, the anonymity created by the buzz of background noise in restaurants has provided situation comedies such as *Seinfeld* and *Two and a Half Men* with fodder for break-up scenes in public. The theory basically is that one can end a relationship over

146. *Id.* at 283.

147. *Id.*

148. *Id.*

149. *Id.* at 282.

150. *Id.* at 283.

151. United States v. White, 401 U.S. 745, 752 (1971).

dinner without other diners knowing, believing that the jilted lover will not choose to make a public scene. Here, the understood custom is that others will not learn of the breakup unless one of those in the dying relationship chooses to draw attention to it by loud or indiscrete behavior.

In defiance of such norms, the Supreme Court's precedent directs people intending such conversations to hunker down at home. *Karo* provided Fourth Amendment protection against government surveillance of a beeper signal because, once the beeper entered the home, it left the area where surveillance was permitted in *Knotts*.[152] The beeper told government agents "that a particular article [was] actually located at a particular time in the private residence."[153] The distinction in *Karo* between the outside and inside of a home was not accidental, for the Court explicitly noted, "[a]t the risk of belaboring the obvious, private residences are places in which the individual normally expects privacy free of governmental intrusion not authorized by a warrant, and that expectation is plainly one that society is prepared to recognize as justifiable."[154]

As previously discussed, the Court solidified the special privacy status of the home in *Ciraolo*, with Chief Justice Burger recognizing the sanctity of privacy expectations in both the home and its surrounding curtilage.[155] Yet, he found no reasonable expectation of privacy in the curtilage of the home from observations made "in a physically nonintrusive manner."[156] Such language sounds uncomfortably similar to the physical penetration language rejected in *Katz*.[157] Despite this similarity, the Court in *Riley* reiterated the "no physical invasion" rationale.[158] Thus, the Court has consistently allowed the government to employ technology in monitoring citizens outside the home and curtilage while maintaining privacy within the residence.

This dichotomy is most dramatic in cases involving cutting-edge technology, such as *Kyllo*, which involved thermal-imaging technology, and *Dow Chemical Co. v. United States*.[159] In *Dow*, the Environmental Protection Agency (EPA) used a "precision aerial mapping camera" to photograph a Dow facility from altitudes of 12,000, 3,000 and 1,200 feet."[160] Chief Justice Burger, writing for the Court, granted the EPA, as a government agency, "greater latitude" in conducting its warrantless inspections because Dow's

152. United States v. Karo, 468 U.S. 705, 714 (1983).

153. *Id.* at 715.

154. *Id.* at 714.

155. California v. Ciraolo, 476 U.S. 207, 212-13 (1986).

156. *Id.* at 213.

157. Katz v. United States, 389 U.S. 347, 351 (1967).

158. Florida v. Riley, 488 U.S. 445, 449 (1989).

159. Dow Chem. Co. v. United States, 476 U.S. 227, 229 (1986).

160. *Id.*

commercial property differed "significantly from the sanctity accorded an individual's home."[161]

Most telling was the Court's discussion of the technology employed in the case. Although the EPA conceded that the use of "highly sophisticated surveillance equipment" that is not publicly available, such as satellite technology, might be unconstitutional without a warrant, Chief Justice Burger concluded that the photographs in this case did not reveal such intimate details so as to raise constitutional concerns.[162] He contrasted the EPA's mapping camera with "some unique sensory device that, for example, could penetrate the walls of buildings and record conversations."[163] The *Dow* Court was particularly concerned with the penetration of walls, and the Chief Justice repeated that "[a]n electronic device to penetrate walls or windows so as to hear and record confidential discussions . . . would raise very different and far more serious questions."[164] In the specific context of sophisticated surveillance technology, the Court again focused both on the importance of the home for privacy and on penetration of walls. *Dow* suggests that the Supreme Court is most receptive to privacy claims when the surveillance actually penetrates the home.

Such analysis shows the limits of the Supreme Court's imagination when considering privacy invasions; the justices seem incapable of envisioning a violation of privacy unless the technology at issue enables the government to sense something hidden by a physical barrier. The Supreme Court's inability to think beyond the tangible was shown in *Kyllo,* where the Court took offense with the use of thermal-imaging technology because it could detect heat emanating from behind the walls of a private home.[165] In *Kyllo*, Justice Scalia analyzed an invasion of privacy in concrete terms by declaring that "any information regarding the interior of the home that could not otherwise have been obtained without physical 'intrusion into a constitutionally protected area' constitutes a search."[166] Thus, in the name of protecting Fourth Amendment freedoms, the Court drew a "firm line at the entrance of a house," congratulating itself that it had made this boundary line "not only firm but bright."[167]

The cumulative impact from the Court's precedent seems clear – to genuinely ensure privacy from government prying, one should "retreat into his own home."[168] To avoid beepers, planes, helicopters, high-resolution cam-

161. *Id.* at 237-38.

162. *Id.* at 238.

163. *Id.* at 237.

164. *Id.* at 239.

165. *See* Kyllo v. United States, 533 U.S. 27, 29, 34 (2001).

166. *Id.* at 34.

167. *Id.* at 40 (citation omitted).

168. *Id.* at 31 (citation omitted).

eras, and thermal detectors, one should become a hermit. If you want the government to leave you alone, go into your personal bunker.

C. Cyborg Moth Technology, Considered in Light of the Court's "Assumption of the Risk" Precedent, Might Squelch Interaction Among Persons in their Daily Lives

Even if a person follows the Supreme Court's suggestion to stay in her home, such a retreat still might not provide a safe haven from government intrusion. In *White*, after all, James White was in his home when Harvey Jackson, the confidant to whom he extended his hospitality, broadcast their conversation via a concealed radio transmitter. The sanctity of White's home did not save him from the government's reach because he was basically a crook betrayed by his own bad judgment.[169] Justice White noted:

> Inescapably, one contemplating illegal activities must realize and risk that his companions may be reporting to the police. If he sufficiently doubts their trustworthiness, the association will very probably end or never materialize. But if he has no doubts, or allays them, or risks what doubt he has, the risk is his.[170]

This rationale, in the context of criminal conspiracy, has the merit of rough justice: if you do something unlawful, you should assume that an associate has the same lack of scruples and will expose you.

The Supreme Court, however, has not limited its assumption of risk analysis to wrongdoers disclosing information to co-conspirators. In *Smith*, the Court deemed that Smith, in dialing numbers to place a call, "voluntarily conveyed" and "exposed" information to a third party, thus undermining the reasonableness of his expectation of privacy in that information.[171] No one claimed, however, that the phone company was somehow complicit as a collaborator in Smith's wrongdoings. Similarly, in *United States v. Miller*, the information contained in financial documents such as checks, statements, and deposit slips was placed outside of a legitimate expectation of privacy because it was "voluntarily conveyed to the banks and exposed to their employees in the ordinary course of business.[172] According to the Court, a depositor takes a risk, when revealing his financial affairs to another person, that the other person will convey that information to the government.[173] Simply stated, the Fourth Amendment

> [D]oes not prohibit the obtaining of information revealed to a third party and conveyed by him to Government authorities, even

169. United States v. White, 401 U.S. 745, 752 (1971).

170. *Id.*

171. Smith v. Maryland, 442 U.S. 735, 744 (1979).

172. United States v. Miller, 425 U.S. 435, 442 (1976).

173. *Id.* at 443.

> if the information is revealed on the assumption that it will be used only for a limited purpose and the confidence placed in the third party will not be betrayed.[174]

Miller could not reasonably expect privacy from his bank even though the bank itself was in no way involved in his criminality.

Furthermore, what is true for financial documents is also true for trash. In *California v. Greenwood*, the Supreme Court determined that residents of the Greenwood house were exposing their own garbage to the public when they placed their trash on the curb, thus defeating their claims to Fourth Amendment protection.[175] The *Greenwood* Court came to this conclusion in part because of the fact that the residents "placed their refuse at the curb for the express purpose of conveying it to a third party, the trash collector, who might himself have sorted through respondents' trash or permitted others, such as the police, to do so."[176] Once again, this assumption of risk of exposure was not based on any character flaw of the trash collector. Nor is the conveying of phone numbers, checks, or trash committed only by wrongdoers. The Supremes Court's assumption of risk precedent effectively signals to all citizens that sharing a secret with one person is the same as sharing it with all persons, including the government. To confide in another is to expose private information and thus undermine the reasonableness of one's privacy expectation, and attendant Fourth Amendment protection. Guaranteeing Fourth Amendment privacy requires an individual to always suspect others, to shut out friends and family, and to be alone.

V. CONCLUSION

At a 2007 anti-war rally in Washington D.C.'s Lafayette Square, college student Vanessa Alarcon heard someone say, "[o]h my god, look at those."[177] When Vanessa looked, she responded, "[w]hat the hell is that?"[178] She described what appeared to be "kind of like dragonflies or little helicopters. But I mean, those are not insects."[179] A Washington lawyer was likewise taken aback, declaring, "I'd never seen anything like it in my life. They were large for dragonflies. I thought, 'Is this mechanical, or is it alive?"[180] Perhaps, it was a bit of both.

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174. *Id.* (citation omitted).

175. California v. Greenwood, 486 U.S. 35, 37, 40 (1987).

176. *Id.* at 40.

177. Rick Weiss, *Dragonfly or Insect Spy? Scientists at Work on Robobugs*, WASH. POST, Oct. 9, 2007, at A03.

178. *Id.*

179. *Id.*

180. *Id.*

Jerry Louton, an entomologist at the National Museum of Natural History, surmised that the flying objects were probably just dragonflies.[181] In fact, biologists themselves think dragonflies "look about as robotic as a living creature can look."[182]Louton has gone so far as to declare that some dragonflies "can knock your socks off."[183] Still, a few details do not make sense, such as the fact that three observers at Lafayette Square "described a row of spheres, the size of small berries, attached along the tails of the big dragonflies—an accoutrement that Louton could not explain."[184] Furthermore, some of the flyers were "maneuvering in unison," a type of behavior that is not seen in dragonflies.[185]

It is certainly possible that the marchers saw robotic flyers, especially since the Department of Defense uses nearly one hundred different models ranging in size from a bird to a small plane.[186] These flying robots have logged so many hours (more than 160,000 flight hours in 2006) that "the glut of unmanned vehicles 'could render military airspace chaotic and potentially dangerous.' "[187]

Whether the flyers were insects, robotic spy drones, or some combination of the two, the resulting feeling of always being watched may be in the process of changing from unjustified suspicion into a rational concern. Once paranoia becomes a reasonable expectation about our privacy limitations, Fourth Amendment protection from a search, as defined in *Katz*, dwindles to nothing. When the Supreme Court's precedent limits privacy protection from technology's intrusions to those who "retreat into [their] own home,"[188] a person will fear to expose her true self outside of her private residence. Finally, even when a citizen stays within the confines of her four walls, the

181. *Id.*

182. *Id.*

183. *Id.*

184. *Id.*

185. *Id.*

186. *Id.*

187. *Id.* The attempt to create a fully mechanical drone the size of an insect has run into difficulties. *See* Ayesa Paul et al., *Surgically Implanted Micro-Platforms in Manduca Sexta Moths*, http://sonicmems.ece.cornell.edu/publications/hh06_paul.pdf (last visited Aug. 12, 2008) ("Over the past four decades, tremendous interest has developed in creating cm-scale autonomous micro aerial vehicles (MAV) for applications ranging from reconnaissance in the battlefield to environmental monitoring. . .. However, the power sources for the flight of a mechanical MAV have not scaled down well. Hence attempts by aerodynamic and robotic engineers to create mechanical MAVs have only met with limited success"). Thus, the HI-MEMS cyborg moth program offered scientists an opportunity to shrink vehicles further by relying on insects, creating a less detectable monitoring system.

188. Kyllo v. United States, 533 U.S. 27, 31 (2001).

Supreme Court's rulings instruct her to guard her words when others come to visit.[189] When Justice Scalia considered thermal imaging in *Kyllo*, he framed the question confronting the Court as "[w]hat limits there are upon this power of technology to shrink the realm of guaranteed privacy."[190] The same question might arise again should the government employ cyborg moths.

189. United States v. White, 401 U.S. 745, 753 (1971).

190. *Kyllo*, 533 U.S. at 34.